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ABSTRACT

Data generated from a survey of western dairy farms is used to determine the characteristics of dairy farmers who have undertaken to improve security measures on their farms during the past two or three years. The findings suggest that decisions to improve on-farm security are influenced by the producer's awareness of how to develop a security policy and also the size of the dairy operation. The results also support the notion that farms may be vulnerable to bioterrorist attacks because most farmers do not believe it is important to establish on-farm security policies.

JEL Classifications: Q10, Q12, Q16

Key words: on-farm security, bioterrorism, dairy farms

DETERMINANTS OF ADOPTION OF SECURITY SYSTEMS TO ADDRESS BIOTERRORIST THREATS: AN ANALYSIS OF DAIRY FARMS IN THE WESTERN UNITED STATES

After the terrorist attacks of September 11, 2001, the United States needed to consider in a profound way all its potential vulnerabilities (National Academy of Sciences). One area of potential vulnerability that quickly surfaced was the U.S. food supply because, obviously, everyone consumes food and because of the importance of the food industry to the U.S. and international economy.

The U.S. food safety inspection system was organized to detect and eradicate food safety problems resulting from unintentional contaminations, especially related to pathogens (National Academy of Sciences; Bailey). The specter of bioterrorism (intentional contamination) presented an entirely new set of issues for the food industry and government food regulators to deal with regarding how to ensure the safety of the U.S. food supply. For example, in an instance of bioterrorism the food safety system needs to deal with the fact that the perpetrator chooses the time, place, and type of contamination that will occur rather than the seemingly random acts associated with unintentional contamination.

The National Academy of Sciences indicates that, "Technical sophistication would not be necessary for attacks [on U.S. agriculture]," and that "Although an attack . . . is highly unlikely to result in famine or malnutrition, the possible damage includes major direct and indirect costs to the agricultural and national economy, adverse public-health effects, loss of public confidence in the food system and in public officials, and widespread public concern and confusion." The U.S. agriculture/food industry accounts for about $1 trillion annually in economic activity or 13% of the Unites States' gross domestic product and about 18% of domestic employment

(Smith; Dyckman). Consequently, a terrorist attack on the U.S. food system would have the potential of inflicting a substantial level of human and/or economic damage.

In testimony to the U.S. Senate, the United States General Accounting Office (GAO) suggests that a terrorist attack on the U.S. food system intended to destroy human life would likely be directed at finished food products while an attempt to disrupt economic activity would probably take the form of an attack on crops or livestock (Dyckman). However, experts generally agree that a bioterrorist attack could occur at virtually any level of the food marketing chain (Dyckman; National Academy of Sciences).

Besides its importance as a basic industry, agriculture appears to be vulnerable to attack, especially at the farm level, for a number of other reasons. First, there are a relatively large number or farms providing a large pool of potential targets. Second, some production enterprises, especially livestock, are concentrated in large numbers in certain geographic locations making it potentially easy to infect a large number of livestock with relative ease. Third, agricultural products tend to move over significant geographical distances to intermediate production, processing, and consumption locations making the potential for spreading disease or other types of deadly material through natural day-to-day business activities an added threat. Finally, many experts suggest that biosecurity measures on farms in the United States are woefully inadequate. Smith refers to farming as ". . . an exceptionally porous industry from a security standpoint." Davis indicates that, "The poor level of biosecurity on the majority of farms today guarantees unchallenged and unhindered access to the determined, patient terrorist."

Much of the concern at the farm level about biosecurity is related to the intentional spreading of highly contagious animal diseases such as foot-and-mouth disease (Dyckman; National Academy of Sciences). But there are also concerns about other contaminants that can cause adverse health effects in humans such as the spread of deadly agents such as anthrax. Agents with less deadly consequences but still holding the potential for adverse effects to human include the intentional contamination of milk with antibiotics such as was suspected in a few cases in New York (Clinton).

The two components necessary for a successful terrorism act are vulnerability and capability (Siegrist) and, unfortunately, U.S. agriculture appears to present both of these prerequisites to potential terrorists (Smith; Davis; Dyckman; National Academy of Sciences). While bioterrorism could occur at any level of the marketing chain, one could argue that routine security measures at processing plants and other points in the chain are better, on the average, than at the farm level thus potentially rendering the farm level as the "weak link" in the food chain in relationship to bioterrorism. Consequently, this paper examines the attitudes and practices of a sample of dairy farmer located in the western United States in relation to the potential threat of bioterrorist attacks. Data for this sample were obtained through a survey which ascertained if these farmers view bioterrorism as a threat to their individual farming operation and if they have taken any measures to safeguard against possible intentional contamination on their farms.

A number of different crop and livestock enterprises could have been selected for this analysis. However, the dairy industry was selected because (1) it has been the target of suspected bioterrorist acts before (e.g., Clinton), (2) given the close confinement and relatively large size of most dairy herds (say, compared to beef herds), and (3) the fact that milk is routinely commingled at the processing plant with milk from other farms, thus potentially providing terrorists with the means of inflicting for spreading contamination broadly from a single point..

Background and Methodology

Virtually no published research is available about the economics of establishing security on farms against a possible bioterrorist attack. Much of the literature tends to focus on how agricultural products can function as a medium for the spread of animal and human diseases (e.g., Davis; National Academy of Sciences). In a related fashion, other literature has examined public health policy in relation to terrorist attacks and appropriate reactions to such attacks (e.g., Avery; McDade; Fidler). Brookmeyer and Blades discuss appropriate modeling procedures for the spread of disease resulting from a bioterrorist attacks using the 2001 U.S. anthrax outbreak as a backdrop. Educational materials dealing with agroterrorism have been prepared by the U.S. government and land-grant universities (EDEN; USDA, FSIS). But, we are unaware of scientific studies examining issues and concerns related to preparedness against a bioterrorist attack at the individual farm level

The reason for this lack may be due to a perceived low level of risk that exists for any particular farm. But we are aware of no scientific studies examining even basic actions taken by farmers as security measures against bioterrorism such as locking milk storage tanks when not in use[1] or monitoring against uninvited persons having access to the farmer's property. Consequently, this study offers an initial examination of whether or not very basic types of security measures are being undertaken of dairy farms, or if a security plan is even in place on these farms.

A survey was developed and sent by mail to dairy farmers who receive the *Utah Dairy Newsletter*. Table 1 provides statistics for the number of surveys sent, response rate, and

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[1] Locking milk tanks is one method suggested as an on-farm risk management practice against intentional or unintentional contamination of milk (Reed).

information about the representativeness of the sample compared to the population. The sample appeared to be quite representative of the population for all states except Idaho where the average number of cows per herd for survey respondents was substantially and statistically lower than the population mean for herd size (Table 1). The survey data obtained from respondents in Idaho represents the lowest percentage of the total cow numbers with only about 1% being represented. The state with the highest percentage of cows represented in data from the survey was Nevada with 37% of the total population. The survey data represented 7% of the total population of dairy cows in the five states included in the survey.

Selected survey questions, together with frequencies of responses, and variable names associated with the selected survey questions are presented in Table 2. The survey questions were developed to determine what actions dairy farmers have taken relative to security measures against possible bioterrorist threats. For example questions were asked about potential for unauthorized access to the farm (*UNNOTICE*), milk tank (*BULK*), and feeding areas (*FEED*) and how frequently unauthorized persons are found on the farm (*UNAUTHP*). Questions were also asked to determine if the farmer believed that security was important on the dairy (*IMPSECUR*) and if they had made changes in the last 2-3 years to improve security on their farm (*SECURITY*) and if they had a security policy in place (*POLICY*). Other questions were asked to ascertain how many hours per day the production areas on the farm are left unattended (i.e., or, conversely, how many hours per day these areas are under direct observation by the farmer) (*UNATTEND*). Finally, the farmer was asked if they had had cases of unintentional and intentional contamination on their farm in the past (*CONTAM*).

The survey data provide general information about the security situation on the dairy farms in this sample. Additional insights might be gained if statistical techniques are used to identify the determinants of why some farmers have undertaken actions to improve security on their farms and some have not. For example, one might ask why some farmers believe security measures are important while some do not or why some have actually taken steps to improve security on their farms while others have not.

In cases where only action or inaction is observable, an index function model may be the best method to describe the probability of an action being carried out or not. In this case we observe whether or not the survey respondent has actually taken steps to improve security on his/her farm during the recent past (2-3 years) (*SECURITY*).

Greene (2003) suggests that survey participants will base their response, in this case on whether or not respondents have improved security on their farm, on "a marginal benefit-marginal cost calculation" of the perceived net benefit from improving on-farm security compared to not doing so (Greene, p. 668). Greene (2003: p. 669) demonstrates the difference between cost and benefit as an unobservable index variable, y*, in the following model:

(1) $$y^* = x'\beta + \varepsilon$$

where the error term, ε, is described as an "innocent normalization" since its actual variance is not known. However, if the actual variance were known, a normalization of the observed data (y and x) would not be changed (Greene, p. 669). The explanatory variables and parameter estimates are represented in this model by X and β, respectively. The model presented by Greene (2003: p.669) shows that because the survey measures only whether steps have been taken to improve on-farm security or not (*SECURITY* in Table 2), then the observed choice is demonstrated by

(2) $$y = 1 \text{ if } y^* > 0 \text{ and } y = 0 \text{ if } y^* \leq 0.$$

Greene (2003: p. 669) states that a constant term must be included in the latent regression if the threshold for y* is zero. This is because the marginal cost and benefits are being evaluated indirectly through participants' choice to undertake on-farm security improvement (*SECURITY* = 1) or not to do so (*SECURITY* = 0) (Greene 2003: p. 669). Obviously, *SECURITY* is an imperfect measure of efforts to increase on-farm security measures because it doesn't provide detail regarding the level or the quality of measures that the farm operator has undertaken to improve security. However, considering that only about 24% of the sample (30/125 see Table 2 which catalogues the survey questions used to obtain responses, frequency of responses, mean responses for the explanatory variables) have undertaken measures to increase security on their farms in the last two or three years, and increased understanding of why some farmers have taken any steps to improve security, while the majority has not, may be important. The following equation shows a model for probability if the distribution of the error term is symmetric:

(3) $\text{Prob}(y^* > 0 \mid x) = \text{Prob}(\varepsilon < x'\beta \mid x) = F(x'\beta).$

For normally distributed disturbances, either a logit or probit model may be used to estimate the probabilities according to Greene (2003: p. 670). The variables explaining whether or not the farmer has improved security on his/her dairy farm in the past two or three years are given by *UNATTEND, POLICY, IMPSECUR, EXPER, UNAUTHP, KNOWCOST, CONTAM,* and *MILKING* (Table 2).

If *UNATTEND* equals one, it indicates that the dairy is left unattended fewer than 12 hours each day. The a *priori* expectation is that the fewer hours the dairy is left unattended the less need there is to implement added security measures. Consequently, the expected sign for the estimated parameter for *UNATTEND* in a regression analysis is negative. If the dairy operator has a security polity in place, one would expect that efforts are more likely to have been made to improve security on the farm in the last few years. Consequently, *POLICY*'s expected sign for its estimated parameter is positive. If the farmer professes to believe that security measures against bioterrorism are important (*IMSECUR*), then one would expect a higher likelihood that the farmer has taken measures to improve security on his/her farm and the expected sign of the parameter estimate for *IMSECUR* is positive. The effect of experience (*EXPER*) on whether or not a dairy operator has increased security in the past few years is uncertain because the threat of bioterrorism is relatively new. Consequently, it is uncertain how the level of experience might affect the decision to increase on-farm security measures because likely all of the dairy farmers in the sample have had the same amount of experience with the specter of bioterrorism because it is so new.

If unauthorized persons are frequently found on the farm (*UNAUTHP*) one would expect that the farmer's level of concern about intentional contamination would be heightened. Consequently, the *a priori* sign for *UNAUTHP*'s parameter estimate is positive. If the farmer has an idea of how much security improvements would cost (*KNOWCOST*), he or she must have at least thought about and probably made an effort to obtain these. Also, if he/she has been the victim of either intentional or unintentional contamination before (*CONTAM*) one would expect the farmer to be more sensitive of the potential threat of intentional contamination. For these reasons, the expected signs for the parameter estimates for *KNOWCOST* and *CONTAM* are both positive. Finally, the size of the milking herd (*MILKING*) likely increases the expected costs of a bioterrorist threat because a single act of intentional contamination potentially affects more animals and/or product. This suggests the probability of a bioterrorist attack may be greater for larger dairies and that the cost of such an attack would be greater for larger dairies than for smaller dairies. Consequently, one would expect the sign for the parameter estimate for *MILKING* to be positive.

Taken as a whole, the results will provide an initial measure of on-farm preparedness for dairy farms in this geographic region relating to bioterrorism. This is based on the representativeness of most of the sample (four out of five states) and the information provided by the survey and statistical analysis. This information should be helpful in gauging the need to improve awareness and therefore providing a backdrop for educational programs for dairy farmers in this region about bioterrorist threats.

Results

The frequencies and means of survey responses reported in Table 2 provided basic information on farmers' characteristics, their attitudes about biosecurity issues, and whether or not they have recently improved security on their farms. The farmers that were surveyed are experienced with most having at least 16 years of experience as dairy farmers and almost half having more than 25 years of experience (*EXPER* in Table 2). Most of the dairies are left unattended fewer than eight hours per day (*UNATTEND*) and 62% (78 out of 126) left unattended fewer than five hours per day. This suggests a high level of direct observation of the operation by the farmer or employees and indicates that the window of opportunity for an external (non-employee) bioterrorist to conduct operations undetected is limited to a few hours each day, probably at night. Only 22% of operations have a security policy in place (*POLICY*). This was a surprisingly low number, but may indicate that limited discussion and information about developing a plan has been provided to these farmers. Most of the farmers (almost 68%) either strongly agree or agree that it would be possible for an uninvited visitor to enter the farm unnoticed (*UNNOTICE*). This suggests that most of these farmers believe that an external bioterrorist could slip unnoticed onto their farms. The majority of respondents also believe that it would be possible to gain unauthorized access to the bulk tank (*BULK*) and feeding areas (*FEED*) on his/her farm.[2] Also, the milk storage tank is left unlocked on almost all of the farms surveyed (*LOCKLID*).

About half of respondents (46.8%) indicate that they either strongly agree or agree that security measures would be important on their farm (*IMPSECUR*). But about 35% of the respondents (44 out of 126) are unsure whether or not the need for security measures on their farm is important. Only 18% of respondents (23 out of 126) are quite certain that security measures on their farm are unimportant (respondent either disagrees or strongly disagrees with *IMPSECUR* in Table 2). Only about 14% of respondents believed they knew how much it would cost to increase farm storage security for raw milk (*KNOWCOST*). Interestingly, over 22% of the respondents had experienced a problem with unintentional or intentional contamination (*CONTAM*). While almost all of these cases were unintentional contamination, two respondents reported they had experienced intentional contamination. This suggests that even if security measures are not directed toward external bioterrorists, that intentional contamination by employees or former employees is a potential threat that may need to be considered.

The survey results appear to confirm other assessments (e.g., National Academy of Sciences; Davis) that there may be relatively easy opportunities for bioterrorists to attack the food system at the farm level. The level of concern and level of preparedness appears to be mixed on these dairy farms, but leans toward unconcern and not being prepared. Obviously, this relates to the individual risk assessments each farmer makes about the threat of an attack on

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[2] Obviously, an unauthorized person would need to enter the farm to gain access to the milk tank or the feeding areas. These questions, *BULK* and *FEED* were asked to ascertain if particular areas of the farm were more vulnerable than others.

his/her individual farm. However, at the least the results suggest the need for additional information about potential threats and possible security measures that farmers could undertake that might counteract these threats at least to some degree. Costs of implementing security measures are likely a major consideration for these farmers and more information about specific security weaknesses and costs to address to develop protocols and systems to begin to address those weaknesses need to be researched.

The parameter estimates and marginal effects for the binomial logit analysis for respondent characteristics contributing to the decision to implement new or added security or not are reported in Table 3. The results suggest that the farmers most likely to have implemented improved security on their farms are those with a security policy in place (*POLICY*), know the costs for implementing improved security (*KNOWCOST*), and who have large dairies (*MILKING*). One might expect there to be a correlation between having recently completed security improvements and knowing the costs for doing so (*KNOWCOST*).[3] So, perhaps the two characteristics identified by the analysis presented in Table 3 that might offer new insights about the decision to improve security or not are *POLICY* and *MILKING*. *POLICY* is probably affected by the level of information a producer has about security systems and protocols and suggests that education about how to develop these policies would aid in the implementation of added security measures on dairy farms. However, the results also seem to suggest that the size of the operation is a very important determinant regarding recent decisions to improve security. This makes sense because there are probably economies of size associated with security improvements which would decrease the per-unit cost of these improvements on large dairies compared to smaller dairies. For example, the marginal effect for *MILKING* suggests that a

[3]The marginal effect for *KNOWCOST* indicates that a dairy operator that knew the costs for additional security was a little more than 21% more likely to have implemented recent security improvements than an operator that did not know these costs.

dairy with 1,100 cows would have an added probability of 40% of having recently completed security improvements compared to a dairy with just 100 cows.

In connection with the analysis presented in Table 3, a second logit model was estimated to determine the characteristics of respondents that believe security measures on dairy farms are important compared to those who do not (*IMPSECUR*). The results of this second analysis are presented in Table 4 and suggest that farmers with less experience (*EXPER*), who have a security policy for their farm (*POLICY*), and who have had frequent problems with unauthorized people on their farm (*UNAUTHP*) are the respondents most likely to believe that security measures are important. The models in Tables 3 and 4 tend do not predict responses of "1" extremely well, but appear to do a reasonable job of predicting "0." This suggests other unknown variables not captured by the survey responses contribute to the decision to implement increased security measures, but we are uncertain what these other variables might be.

In general, the results support the notion that farms (in this case dairies) could be vulnerable to a bioterrorist attack because most farmers do not believe it is important to do so, are not engaged in establishing security policies, and have not taken steps to improve security on their farms. Larger dairies are more likely to have implemented improved security. This is a positive result if one believes that the greatest threat is to large farms. The results indicate that many farmers are ambivalent about increased security measures on the farms. This may reflect that many farmers perceive a very small risk to their individual operation and are willing to bear that risk. Educational efforts, such as extension programming, will need to recognize that many farmers, especially those with small or mid-sized operations, may be unwilling to spend significant amounts of money to upgrade their security practices. Consequently, educational efforts for these operators may with to focus on low-cost, and perhaps, partial solutions to improving on-farm security. However, larger farm operators may be willing to consider more sophisticated and costly security upgrades.

Conclusions

The U.S. food and agriculture system is considered vulnerable to bioterrorist attacks. This study examined survey data from dairy farmers in the western United States to determine if these farmers had made recent improvements in their on-farm security systems. The findings indicate that most of the dairy farmers surveyed had not made any recent security improvements and that most do not believe that they need to. For example, farmers with a large amount of experience (older) do not believe that improving security measures are important. Farmers with larger operations are more likely to have made recent security improvements than farmers with smaller operations. Having an on-farm security policy appeared to be an indicator of whether or not a farmers had made recent security improvements and also if they believed that improving security was important.

The results suggest that, if the government believes that security education is important for farmers, different approaches to education about on-farm security will probably need to be taken with smaller and larger farmers. Educational efforts should probably focus on the potential risks from bioterrorists and disgruntled employees farmers face and should also focus on developing a security policy for the farm.

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Table 1. Survey and Population Statistics for Dairy Farmers for Selected States in the Western United States

State	Total Dairy Herds	Surveys Sent	Surveys Returned	Response Rate (%)	Cows in Sample	Total Dairy Cows in State	Mean Herd Size Sample	Mean Herd Size State
Utah[a]	360	268	77	29%	19,943	91,000	259	253
Montana[b]	110	98	16	16%	2,416	18,000	151	164
Idaho[c]	755	84	22	26%	4,114	404,000	187*	535
Nevada[d]	35	35	9	26%	9,702	26,000	1,087	867
Wyoming[e]	30	15	2	13%	282	3,800	141	109

* Statistically different from the state mean herd size at the 1% level of confidence.
[a] Source: *2004 Utah Agricultural Statistics.*
[b] Source: *2004 Montana Agricultural Statistics.*
[c] Source: *2004 Idaho Agricultural Statistics.*
[d] Source: *2004 Nevada Agricultural Statistics.*
[e] Source: *2004 Wyoming Agricultural Statistics.*

Table 2. Survey Questions, Frequencies, Mean Responses to Survey Questions, and Variable Names and Values

Question	Responses=Code	Frequencies	Mean Response	Variable Name and Value
How many dairy cows are you currently milking?	Continuous variable		250	*MILKING*
How many years have you been directly involved in the dairy industry?	< 5=1	4		
	6-15=2	26		
	16-25=3	31	3.48	*EXPER=1* if e>2,
	26-35=4	36		code>2, 0
	36+=5	30		otherwise
How many hours per day is the dairy is left unattended?	< 5=1	78		
	6-8=2	29		
	9-11=3	14	1.58	*UNATTEND*=1 if
	12-14=4	4		code<3, 0
	15+=5	1		otherwise
Do you have a security policy in place?	Yes=1	28		
	No=2	99	1.78	*POLICY*=1 if
	Don't know=3	0		code=1, 0 otherwise
It would be possible for a visitor to enter the farm unnoticed.	Strongly agree=1	18		
	Agree=2	68		
	Unsure=3	13	2.44	*UNNOTICE*=1 if
	Disagree=4	23		code<3, 0
	Strongly disagree=5	5		otherwise
If would be possible for a visitor or an unauthorized employee to enter the bulk tank milk storage area unnoticed.	Strongly agree=1	19		
	Agree=2	73		
	Unsure=3	11	2.35	*BULK*=1 if
	Disagree=4	19		code<3, 0
	Strongly disagree=5	5		otherwise
It would be possible for a visitor to enter the feed storage area unnoticed.	Strongly agree=1	25		
	Agree=2	74		
	Unsure=3	12	2.18	*FEED*=1 if
	Disagree=4	12		code<3, 0
	Strongly disagree=5	4		otherwise
Unauthorized people are found on the farm.	Very frequently=1	3		
	Frequently=2	6		
	Sometimes=3	25	3.75	*UNAUTHP*=1, if
	Rarely=4	79		code<3, 0
	Never=5	14		otherwise

Table 2. (Continued)

Question	Responses=Code	Frequencies	Mean Response	Variable Name and Value
The milk storage tank is locked when the parlor is not in operation.	Always=1	2		
	Frequently=2	2		
	Sometimes=3	0	4.83	*LOCKLID*=1, if
	Rarely=4	4		code<3, 0
	Never=5	116		otherwise
Do you consider the need for security measures on your farm important?	Strongly agree=1	9		
	Agree=2	50		
	Unsure=3	44	2.71	*IMPSECUR*=1, if
	Disagree=4	15		code<3, 0
	Strongly disagree=5	8		otherwise
What would be an approximation of total costs to increase farm storage security for raw milk?	Don't know=1	111	1.12	*KNOWCOST*=1, if
	Know=2	18		code=2, 0 otherwise[a]
Have you increased security on your dairy in the last 2-3 years?	Yes=1	30	1.76	*SECURITY*=1, if
	No=2	95		code=1, 0 otherwise
Have you ever had a problem with intentional or unintentional contamination on your farm?	Yes=1	28[b]	1.78	*CONTAM*=1, if
	No=2	98		code=1, 0 otherwise

[a] Estimates of costs vary from a few dollars to many thousands of dollars and were also based on inconsistent assessments of needs (e.g., a simple lock on the storage tank to closed-circuit television surveillance). Consequently, *KNOWCOST* is used simply as a proxy to establish if the respondent had considered costs to improve surveillance or not.

[b] Of these responds, two indicated that there had been cases of intentional contamination on their farm.

Table 3. Logit Analysis Results Determining Characteristics of Respondent Farmers Who Have Improved Security on Their Farms in the Recent Past (Dependent Variable = *SECURITY*)

Independent Variable	Parameter Estimate[a]	Marginal Effect
Intercept	-3.585**	-0.596**
	(1.102)	(0.161)
UNATTEND	0.875	0.145
	(0.900)	(0.146)
POLICY	0.808[b]	0.134[b]
	(0.607)	(0.101)
IMPSECUR	0.317	0.053
	(0.526)	0.087)
EXPER	0.078	0.129
	(0.646)	(0.107)
UNAUTHP	0.459	0.076
	(0.600)	(0.099)
KNOWCOST	1.289*	0.214*
	(0.683)	(0.113)
CONTAM	0.120	0.020
	(0.586)	(0.097)
MILKING	0.003**	0.0004**
	(0.001)	(0.0002)

Predictions:

	Predicted		
Actual	0	1	Total
0	87	4	91
1	19	10	29
Total	106	14	120

*Statistically different than zero at the 10% level of significance for a two-tailed test.
**Statistically different than zero at the 5% level of significance for a two-tailed test.
[a] Standard errors are in parentheses.
[b] Statistically different than zero at the 10% level of significance for a one-tailed test of the hypothesis that the parameter estimate is positive.

Table 4. Logit Analysis Results Determining Characteristics of Respondent Farmers Who Believe that On-Farm Security Measures Are Important (Dependent Variable = *IMPSECUR*)

Independent Variable	Parameter Estimate[a]	Marginal Effect
Intercept	-0.073 (0.706)	-0.018 (0.176)
UNATTEND	-0.173 (0.584)	-0.043 (0.146)
POLICY	1.277** (0.621)	0.318** (0.155)
SECURITY	0.306 (0.519)	0.076 (0.129)
EXPER	-1.424*** (0.526)	-0.355*** (0.131)
UNAUTHP	0.969** (0.488)	0.242** (0.121)
KNOWCOST	0.220 (0.683)	0.055 (0.170)
CONTAM	0.046 (0.510)	0.012 (0.127)
MILKING	0.0007 (0.001)	0.0002 (0.0002)

Predictions:

	Predicted		
Actual	0	1	Total
0	51	13	64
1	31	25	56
Total	82	38	120

* Statistically different than zero at the 10% level of significance for a two-tailed test.
** Statistically different than zero at the 5% level of significance for a two-tailed test.
***Statistically different than zero at the 1% level of significance for a two-tailed test.
[a] Standard errors are in parentheses.